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ABSTRACT

This experiment studied the extent to which training of two behaviors affects subjective response uncertainity and information seeking. The two behaviors were cue attendance, i.e., analyzing a complex stimulus and identifying its discrete components, and hypotheses generation, i.e., the generation of numerous alternative hypothetical explanations of the nature of a complex stimulus. The subjects, 117 teacher training students, were exposed either to a structured or a random-spliced version of a film in each training condition. A 2 x 2 x 2 factorial design was employed. To this a ninth posttest-only group was added. Results showed that cue-attendance training significantly facilitated later hypothesis-generation behavior as much as direct training. Training for hypothesis generation significantly facilitated later cue-attendance behavior, although not as much as direct training. Both training procedures significantly facilitated information seeking behaviors. In addition, it was found that subjects with high verbal reasoning scores benefited most from hypothesis-generation training in terms of increased information seeking, while low scores profited most from cue attendance training. It was concluded that although a chain of mental processes underlies uncertainity and information seeking, individuals who differ on a relevant aptitude measure emphasize different parts of this chain. (Author/RT).

STANFORD CENTER
FOR RESEARCH AND DEVELOPMENT
IN TEACHING

Technical Report No. 14

CUE ATTENDANCE AND HYPOTHESIS GENERATION AS TWO PROCEDURES OF TRAINING FOR PRODUCING SUBJECTIVE RESPONSE UNCERTAINTY IN TEACHERS

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Introductory Statement

The central mission of the Stanford Center for Research and Development in Teaching is to contribute to the improvement of teaching in American schools. Given the urgency of the times, technological developments, and advances in knowledge from the behavioral sciences about teaching and learning, the Center works on the assumption that a fundamental reformulation of the future role of the teacher will take place. The Center's mission is to specify as clearly, and on as empirical a basis as possible, the direction of that reformulation, to help shape it, to fashion and validate programs for training and retraining teachers in accordance with it, and to develop and test materials and procedures for use in these new training programs.

The Center is at work in three interrelated problem areas: (a) Heuristic Teaching, which aims at promoting self-motivated and sustained inquiry in students, emphasizes affective as well as cognitive processes, and places a high premium upon the uniqueness of each pupil, teacher, and learning situation; (b) The Environment for Teaching, which aims at making schools more flexible so that pupils, teachers, and learning materials can be brought together in ways that take account of their many differences; and (c) Teaching the Disadvantaged, which aims to determine whether more heuristically oriented teachers and more open kinds of schools can and should be developed to improve the education of those currently labeled as the poor and the disadvantaged.

The study reported in Technical Report No. 14, which follows, was done under the Uncertainty Studies project of the Heuristic Teaching program. It describes how training in different uses of uncertainty can facilitate learning, and therefore facilitate teaching, both for those who score high and for those who score low in verbal reasoning ability.

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Abstract

The major purpose of the experiment was to study the extent to which training of two behaviors, which were hypothesized to underlie subjective response uncertainty and curiosity, affect the latter. The two behaviors were cue attendance, i.e., analyzing a complex stimulus and responding verbally to its discrete components, and hypothesis generation, i.e., the generation of numerous alternative hypothetical explanations of the nature of a complex stimulus. The choice of these two behaviors was based on previous data which suggested that the analysis of a complex stimulus facilitates the process of generating alternative hypotheses, which in turn facilitates the production of subjective uncertainty. The resolution of the latter state is done through the search for novel information (curiosity). A secondary purpose of the study was to investigate the interaction between properties of stimulus materials and improvements on information search behavior.

Subjects were trained either to attend to cues or to generate hypotheses. In each training condition they were exposed either to a well-structured or to a randomly spliced version of a film. The former was expected to facilitate cue-attendance training while the latter was expected to facilitate training for the generation of alternative hypotheses. A 2 (training vs. control) x 2 (cue-attendance or hypothesis-generation training) x 2 (structured or unstructured version of stimulus film) design was employed. To this, a ninth posttest-only group was added. Subjects were teacher training students at the Stanford School of Education (N=117).

Results showed that cue-attendance training significantly facilitated later hypothesis-generation behavior as much as direct training of the latter. The training for hypothesis generation significantly facilitated later cue-attendance behavior, although not as much as direct training of the latter. Both training procedures significantly facilitated information-seeking and -processing behaviors as measured immediately following training and a week later. The versions of the

stimulus film significantly facilitated the breadth of information sought rather than its quantity. The structured version when used in cue-attendance training, and the unstructured version when used in hypothesis-generation training, led to the subjects' seeking a significantly larger variety of information. In addition, a disordinal interaction was found between Ss' verbal reasoning scores and the kind of training they received in terms of the amount of novel information they sought when faced with a new situation: low scores profited most from cue attendance while high scorers benefited most from the training for the generation of alternative hypotheses.

It was concluded that subjective response uncertainty can be modified by training individuals in the mental processes which underlie the production of uncertainty. It was also concluded that while such modifications are possible, subjects who differ in their verbal reasoning ability benefit differently from such training, suggesting a qualitative difference between the mental processes called for by each of the training tasks. Thus, it was possible to conclude that although a chain of mental processes underlies uncertainty and curiosity, individuals who differ on a relevant aptitude measure emphasize different parts of this chain.

Some theoretical and educational implications are discussed.

CUE ATTENDANCE AND HYPOTHESIS GENERATION
AS TWO PROCEDURES OF TRAINING FOR
PRODUCING SUBJECTIVE RESPONSE
UNCERTAINTY IN TEACHERS

Gavriel Salomon[1,2]

When a stimulus evokes in a person a number of alternative response tendencies, and no response is dominant, subjective response uncertainty is said to exist. Subjective response uncertainty is defined in terms analogous to those employed by information theory as a function of both the number of competing response tendencies and their respective relative strengths (Berlyne, 1960, 1965). The predecision response conflict which results is an aversive internal state similar to that proposed in many cognitive consistency theories.

This aversive state has motivating properties in that it energizes and directs the person to reduce the uncertainty and resolve the conflict among the alternative responses. Of the many alternative responses available, some classes of responses, those leading to the acquisition of new information (curiosity or epistemic behavior) and those which bring information out of storage and manipulate it (symbolic responses), or both, have preeminence over other classes of responses. The apparent reason is that both the acquisition of new information and the symbolic transformation of already available information have either a long and intimate history of association with the reduction of response conflict (Lanzetta, 1967), or are intrinsically motivating (Hunt, 1964).

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[2]The author wishes to thank Drs. Richard E. Snow, Joan S. Suppes, and Nathan Maccoby for their guidance and many helpful suggestions. The author wishes to thank Dr. Suppes in particular for her many editorial comments. Special acknowledgment also goes to Dr. Siegfried Streufert for his comments and suggestions.

When a stimulus arouses numerous response alternatives simultaneously (whether these are associations, procedures, solutions, or strategies of approach), it can be said to provide an insufficient quantity of information, or some amount of negative information. Positive information is understood in this context as that which reduces uncertainty (Garner, 1962), while negative information increases uncertainty. Positive information, so conceived, exists only if preceded by uncertainty. It reduces a many-alternative situation to a few-alternative one, or makes one alternative dominant over the others. A stimulus as described above does not contain sufficient positive information to the extent that it does not favor one of the various responses aroused in the person. The missing positive information is then sought from external sources, generated through the reorganization of the stimulus situation, or retrieved from storage. The purpose of these behaviors is to rule out some of the alternative responses and to unequalize the relative strengths of the remaining ones. It is apparently due to these functions that information acquisition and transformation are reinforcing behaviors and are instrumental in uncertainty reduction.

Numerous consistent findings lend support to the conceptual formalization presented above. These have been summarized recently in a number of papers (e.g., Berlyne, 1965; Kessen, 1966; Sieber & Lanzetta, 1966; Sieber, 1968). Generally, it was observed that GSR readings, time to decision, degree of reported uncertainty, diversity of responses, amount of information search, and complexity of final responses, all covary up to a certain limit with amount of stimulus uncertainty. That is, they covary with the number of alternatives either built into the stimulus or suggested by it.

However, large and consistent individual differences have also been found in adults (e.g., Sieber & Lanzetta, 1964, 1966; Karlins & Lamm, 1967) and in children (e.g., Kagan, 1965) in the amount of subjective response uncertainty they experience as inferred from their behavior. Both in the light of these findings and in the light of Berlyne's theory, it becomes evident that stimulus attributes alone cannot explain the

variations among individuals in the amount of information seeking and processing they manifest, hence in the amount of uncertainty they experience. Even when the importance the problem has in the eyes of the individuals is held constant, there are large differences in the amount of response uncertainty they generate. Some individuals analyze the stimulus in more detail and suggest more alternative responses than others. Some determinants of these individual differences in predecision information processing, such as anxiety, conceptual complexity, motivation, and others, have been studied by Long, Reid, and Henneman (1960), Schroder, Driver, and Streufert (1967), Karlins (1967), Driscoll, Tongoli, and Lanzetta (1966), Sieber and Lanzetta (1966), and others. The general purpose of the present study was to further investigate the cognitive processes which account for the amount of generated uncertainty. More specifically, the study was designed to test the hypothesis that people's subjective response uncertainty is modifiable if the specific mediating processes believed to underlie this state are experimentally manipulated.

This kind of research is concerned with the mediating, thus covert, processes of which certain overt behaviors are believed to be a function. The specification of the covert processes is the first step to be taken. These processes are a series of successive situational and transformational responses that carry the individual from the state of encounter with the stimulus to the state of overt responding. Making this process available for external manipulation serves two functions. It provides support for the hypothesized way in which individuals typically operate under the given conditions. It also lends empirical support to the hypothesis that the resultant behavior under investigation is a learned one, and thus can be brought under external control.

The specification of mediating processes can be derived from previous empirical data, primarily from correlational studies (Glanzer, 1967; Anderson, 1967). When a number of behaviors have been found to intercorrelate in accord with a general conceptual network, some of them may be hypothesized to be functions of others. Once such a mediating behavior has been identified it can be manipulated experimentally. The manipulation of the process is then expected to affect both other mediating processes and the resultant behaviors, such that the hypothesized process

$s \longrightarrow r_1$

$r_1 \longrightarrow r_2$

$r_2 \longrightarrow R$

can be empirically supported.

Prior to the formulation of the present study, numerous behaviors were found to correlate with each other and to differentiate among individuals' behaviors when confronted with potentially high uncertainty-arousing stimuli. These are the detailed study of the stimulus situation and the generation of alternative responses (e.g., solution procedures, inferences, meanings, etc.).

One of the necessary conditions for any creative production seems to be a large supply of information (Guilford, 1967). Put in different words, the more associative responses one can bring to bear upon the stimulus, the more transformations or operations can later be accomplished with this information. As Mednick puts it (1962), an individual without the requisite elements in his response repertoire is not able to combine them so as to arrive at alternative solutions. However, the requisite elements need not only be available but also must be brought to the fore by the individual. A generalized response set, a "strategy" of bringing to the fore many associative responses, needs to be activated. This would facilitate recognition of a complex, ambiguous, or incomplete stimulus as such. Thus, the person needs first to analyze the stimulus, so that the incompatibility, complexity, ambiguity, or incompleteness of the stimulus will be reflected in his responses. Response uncertainty, at this state of responding to the stimulus, should vary inversely with the degree to which several elements of the stimulus are responded to as a unit (Berlyne, 1960). One is reminded, in this connection, of the consistent correlations between "analytic style" and "reflectivity" reported by Kagan (1965). Response uncertainty also increases with dissimilarity between the responses aroused by the stimulus attributes. With more varied responses, alternate ways of chunking them, transforming them, or storing them should become available (Bieri, 1966; Mandler, 1967).

Finally, response uncertainty varies with the unselectivity of attention paid to the stimulus attributes. Information is taken in from a variety of sources or aspects without any dominant attention to one particular attribute, element, or aspect. One is reminded of Mednick's (1962) response hierarchies: The "flatter" the hierarchy of responses one brings to bear upon the stimulus, the more dissimilar the responses that are evoked, and the greater is the probability of generating alternative, equally strong combinations and transformations. The two-string experiment of Birch and Rabinowitz (1951) illustrates the results of inducing a set through training which "steepens" subjects' response hierarchy. Although the appropriate responses were available to the trained subjects, they became less accessible or weaker, relative to the strength of trained responses. The information these subjects attended to was highly selective; it was determined by the set of responses which became dominant because of the preceding training.

It can be argued that the process of associating many responses to a stimulus is uncertainty producing. Given the concept of channel capacity, some processes of chunking, organizing, and transforming the incoming information are needed to facilitate storage for later use (Miller, 1956; Mandler, 1967). Individual differences in processing information cannot be attributed therefore only to the amount, variety, and selectedness of the information taken in (or responded to). This complex process is only one necessary condition.

The other major class of behavior observed to be related to response uncertainty in problem solving, namely the generation of alternative response complexes, seems to be another necessary condition. First, it is very reasonable to hypothesize that this class of transformational responses is a function of the previously discussed responses. Correlational evidence lends support to this contention (e.g., Harvey, Wyer & Hautaluoma, 1964; Tripodi & Bieri, 1964; and others). Second, uncertainty as to which solution procedure to choose, what meaning to assign to a stimulus situation, or what judgment to pass, would be a more important

determinant of conceptual conflict (which apparently leads to epistemic behavior and symbolic transformation) than the state of uncertainty produced by the detailed examination of the stimulus. While the examination of the stimulus underlies the conflict of stimulus selection (e.g., what aspect of the stimulus should be responded to first), the generation of alternative solutions underlies the conflict between response complexes. These complexes are the result rather than the origin of transformation and hence constitute a different kind of uncertainty.

Moreover, detailed examination of the stimulus does not necessarily require highly selective perception, the generation of alternative response complexes would require careful selection of groups of stored pieces of information. This selective focusing on groups of responded-to details is guided by the nature of the task at hand. It determines which elements are eligible for entering into still more complex combinations. When alternative solutions or procedures are generated for consideration, focusing needs to shift in two ways: from one cluster of details to another, and from one transformation to another. Thus, it can be argued that the generation of alternative response complexes is facilitated by the acquisition of unselective information added to the application of alternative transformations.

Given the above arguments, it would be reasonable to expect subjects who become more proficient in analyzing a complex stimulus also to generate more alternative response complexes, become more uncertain, and thus tend to search for more novel information. Becoming more proficient in generating alternative response complexes may indeed lead to more uncertainty and information search but it may not lead to a more detailed analysis of the stimulus. The reason is that the generation of response complexes is apparently a function of stimulus analysis and hence should not operate "backward."

In the present study, the following predictions were advanced: (a) Training for the detailed examination of a stimulus improves the

generation of response alternatives, and thus increases response uncertainty and information search, and (b) training for the generation of response alternatives increases to a limited degree the detail in which a stimulus is examined and increases subjective uncertainty and information search.

(c) Since the two processes involve different constituent behaviors, an interaction between training and relevant aptitude is expected (Cronbach, 1957; Snow & Salomon, 1968). It was therefore predicted that subjects who are very adept at applying numerous alternative transformations to the same information benefit less (in terms of increased uncertainty) from training for the examination of a stimulus than from training for the generation of alternative response complexes. On the other hand, subjects who are less capable of applying various transformations to the same data benefit less from the latter training than from the former. Ability to apply transformations was measured by the Graduate Record Examination (verbal part). (d) Finally, in light of a previous study by Salomon and Sieber (1970), stimuli varying in the degree of stimulus uncertainty are expected to facilitate training differentially. That is to say, when the examination of details is required, a well-structured stimulus contains little of the irrelevant uncertainty needed to arouse the desired uncertainty of stimulus selection. The same stimulus, reconstructed to lose its original structure (hence, predictability) arouses relevant uncertainty (i.e., conceptual uncertainty) only when the generation of alternative response complexes is being trained for.

Method

Design

A 2 x 2 x 2 factorial design was employed. There were two kinds of training procedures, two levels of training, and two kinds of training materials. The two kinds of training procedures were (a) training for close examination of details in a movie (cue attendance), and (b) training for the generation of alternative explanations of the plot of a movie (hypothesis generation). Half of the subjects were either trained to criterion (experimental groups) or were introduced to

the procedures but were not required to respond aloud, or to reach a criterion, and also received no reinforcement (control groups). The two kinds of training materials consisted of either (a) a structured or (b) unstructured film, and subjects were exposed either to one or the other version. Finally, since no pretest measures of subjective uncertainty could be taken due to possible sensitization, another group of control subjects was added to the design. These subjects did not view either training film or receive any set of training instructions, but took only the posttests after receiving their respective treatments.

All subjects were administered posttests of cue attendance, hypothesis generation, and information seeking. In addition, a delayed posttest of information seeking was administered to all subjects seven days later. Verbal scores on the Graduate Record Examination were obtained for all subjects. Performance in the experiment was then examined in relation to training, film structure, and GRE verbal ability score.

Subjects

A sample of 117 teaching interns at the Stanford University School of Education was chosen from a population of 164 interns and divided to form nine groups of 13 subjects. Subjects were chosen and assigned by means of stratified randomization using two stratification variables: sex and field of study. Sex was chosen because Sieber and Lanzetta (1966) found that males and females reacted differently to cue attendance and hypothesis generation treatments. Field of study was chosen because subject areas differ in their information processing requirements and these differences may generalize to performance in the present study.

Training Procedures

Cue attendance. Training for cue attendance (CA) consisted of showing an individual subject one of the film versions and requiring him to

report 150 details.[3] The subject was told that he was participating in a learning experiment and that he would learn how to perceive many subtle details in his environment. He was then told that he would see a film and was to memorize and later report 150 descriptive details. It was stated that he was not expected to make any inferences or interpretations of what the film was about. It was pointed out that the subject would be permitted to see the film as many times as needed to report the required number of details. To illustrate to the subject what was required of him, he was then shown a sample slide depicting 12 school children who were engaged in various activities. While viewing this slide he listened to a tape recording of details being reported by a person who "has participated in the same kind of training . . . and succeeded very well in noticing details." After viewing the sample slide, the subject viewed the film and then began to report the details he noticed. His verbal report was recorded on audiotape. After each detail was reported, the experimenter reinforced the subject by saying "good," "O.K.," or "very good." A response was accepted and reinforced if it (a) described a detail of the film and (b) had not been reported previously by the subject. Reports of details were counted by the experimenter on a hand counter. When the subject showed signs that no additional details were forthcoming, the experimenter offered to let him see the film again to try to notice more details. This procedure continued until the subject had reported 150 cues.

Hypothesis generation. The training for hypothesis generation (HG) consisted of permitting subjects individually to view one of the film versions and requiring each to generate 12[4] hypothetical plots to describe the film. Each subject was told that he was participating in a learning experiment and that he would learn how to generate many explanations of what he saw in his environment. He was then told that

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[3]The criteria to be reached in both cue attendance (150 reported details) and hypothesis generation (12 plots) training were empirically set, based on pilot data. It was suggested by the pilot data that both criteria are equally demanding on the average.

[4]See footnote 3.

he would see a film and would be expected to formulate 12 different hypotheses about the film plot, but was not expected to describe the details of the film. It was pointed out that the subject would be permitted to see the film as many times as needed to formulate the required number of hypothetical explanations. Following the instructions, the subject was shown three sample slides depicting a girl in a library, a boy playing a flute, and a pair of legs running, respectively. He listened to a tape recording of a person who "participated in the same kind of training and succeeded very well in generating hypothetical explanations." The film was then shown, and immediately afterwards, the subject was asked to begin generating his hypothetical explanations. The experimenter reinforced each acceptable hypothesis saying "good," "O.K.," or "very good." To be acceptable, a response had to be a hypothetical plot (a) that took into account all the scenes of the film, and (b) that had not been mentioned previously by the subject. A record was kept of responses and requests for additional viewing of the film as in CA training.

Control conditions. There were five control groups, of which the first four corresponded to the four training groups. To simply the description of the first control groups, they will be further divided into two cue-attendance control groups and two hypothesis-generation control groups. One CA control group viewed the structured film and the other viewed the unstructured film. Each individual in both groups was told he would see a film and that he ought to try to remember many of its subtle details. Each subject was permitted to see the film as many times as he wished and was told that when he thought he could recall many details the experiment would go on. However, the subject was not asked to describe the details he observed and consequently no reinforcement was given. Also, no criterion was set, no sample tape was played. HG control-group subjects (in each film condition) received comparable treatment. Each subject viewed the film and was told to try to formulate many different hypotheses about the plot of the film. However, HG control-group subjects viewed no sample slides, heard no sample tape, and were not asked to respond verbally; consequently no reinforcement was given.

Posttest-only control-group subjects (the added ninth group) did not receive any training instructions or see any of the films. Upon entering the room, they were given only the posttests.

Posttests were given to all subjects in all groups either following the training (in the four experimental groups), following the viewing of the film (in the four no-training control groups), or at the beginning of the session (in the posttest-only control group).

In all nine groups, training or testing was done individually by the experimenter. A third person, an equipment operator, was also present in the room. The equipment consisted of a slide projector, a 16mm film projector, a tape recorder and a stenographic recorder. The subject was seated at a desk 117 inches from the movie screen.

Experimental subjects worked about one and one-half hours on their tasks, and control subjects worked less than an hour. Experimenters, rooms, hours of the day, and order of participation were randomized so that the 13 subjects of each group were evenly divided among experimenters, rooms, and hours of the day.

Stimulus Materials

The two versions of the film used in the study originated from the film, "God's Man," directed by Shelly Fay. The original film is based on black and white wood cuts and is accompanied by music only. A three-minute, 45-second section containing an independent story was taken from this film. Two versions of this section were adopted for this study. In the structured version (S), the various scenes and shots appeared in the same logical order as arranged by the original producer. The unstructured verstion (U) was the result of random editing. That is, a copy of the S version was separated along its original cuts, then randomly re-arranged and spliced.

Measures of the uncertainty-evoking properties of these two film versions under CA and HG instructions were examined in a previous study (Salomon & Sieber, 1970). An interaction was found between task and film version. Under cue-attendance instructions, the structured film produced a relative uncertainty coefficient of $R_H = .62$ and the unstructured film produced $R_H = .57$ ($p < .05$). Conversely, under HG instructions,

the structured film produced $R_H = .58$ and the unstructured film produced $R_H = .99$ ($p < .01$). The measure of group-generated response uncertainty indicates the spread of responses over response-classes, using the formula $H = \Sigma p_i \log_2 \frac{1}{p_i}$, where p_i is the probability of response i to appear in the group distribution of response. H is thus a measure of actual uncertainty. $H_m = \Sigma \log_2 \frac{1}{p_i}$ is a measure of maximum uncertainty which could be generated if all responses were equiprobable. Finally, $R_H = \frac{H}{H_m}$, which is a measure of relative uncertainty; it is a proportion which can enter statistical comparisons (Attneave, 1959).

Variables Measured

Four kinds of measures were obtained: (a) Prior to training, GRE verbal scores and California F-Scale scores were obtained because of their purported relationship to information processing (Schroder et al., 1967; Long & Ziller, 1965). (b) Measures of training behavior were obtained to determine the degree of uncertainty aroused by each film condition, and the relative difficulty of each of the two training procedures. These measures included the number of times each subject asked to see the film and the amount of time required by each experimental subject to reach criterion (excluding time devoted to viewing the film). These measures were obtained from reports which were filled out by the experimenter during training, and from tape recordings of each subject's responses. (c) Posttest measures of cue attendance, hypothesis generation, immediate information search, and delayed information search were obtained from all subjects. Order of posttests was randomized.

In the posttest of cue attendance, each subject viewed three slides of classroom scenes for eight seconds each. He was then required to write down all the details that he noticed. The subject was encouraged to continue to view the slides as long as he thought he could report additional details. Measures were obtained of the number of details reported the number of times the subject asked to see the slide, and the time required to report details between the first and second viewing of the slide.

In the posttest of hypothesis generation, each subject viewed seven slides depicting activities of a high school girl (with a tennis racket, playing with a child, dancing, arguing with a boy, drinking beer and smoking, playing chess with a Playboy Magazine next to her, studying). Each slide was shown for four seconds. The subject was instructed to write down as many different interpretations of the slides as possible, disregarding the order of the slides, but taking into account each slide. Each interpretation was to center around one central problem, issue, or event. The subject was encouraged to view the slides as often as he wished. Measures were obtained of the number of different interpretations generated, the number of times the subject asked to see the slides, and the time needed to respond between first and second viewings.

The scoring of both the cue-attendance posttest and the hypothesis-generation posttest was done by a naive person who had been trained with pilot study materials.

Immediate and delayed posttests were administered to all subjects to measure the amount of information seeking. In the immediate posttest of information seeking, each subject was instructed to write down any factual information questions he felt one should ask before planning English departments of high schools in Spanish-speaking, low socioeconomic communities.[5] A time limit of 15 minutes was set on the test. The number of different factual questions asked by each subject was recorded. The group-averaged response uncertainty (Attneave, 1959) was then calculated for each condition by putting the questions into 14 categories of information (e.g., information about grades, facilities, community, etc.) and then converted this frequency distribution into a probability distribution.

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[5]The test was adapted, with modifications, from Karlins, Lee, and Schroder (1967). These authors found that this test was related to amount of information seeking in a decision-making game ($r = .37$, $n = 65$, $p < .01$), and performance on the Unusual Uses Test ($r = .37$, $n = 65$, $p < .01$), but not significantly related to performance on the Wunderlich Personnel Intelligence Test ($r = -.12$, $n = 65$). In a pilot study, the present experimenter found that this test related to the number of cues subjects reported seeing in a film ($r = .43$, $n = 26$, $p < .05$), and to the number of hypotheses generated about a film plot ($r = .41$, $n = 37$, $p < .01$).

The scorer was naive in that he was not the person who scored the cue-attendance posttest or the hypothesis-generation posttest protocols. He was trained with pilot materials.

Seven days later, a delayed posttest of information seeking was administered. Each subject was to assume the role of a school principal, and to write down all the information items he would like to find in the biographical file of an applicant for the position of expert in racial relations in public schools.[6] A time limit of 15 minutes was set on the test. Procedure for administering and scoring this test was identical to that of the immediate posttest of information seeking.

Results

The scores on all measures except the GRE verbal and F Scale were analyzed twice, once by a 2 x 2 x 2 fixed-effect model of analysis of variance (training control by training procedure by two film versions) to test main effects and interactions, and again by an analysis of variance with nine treatment groups by 13 individuals. The latter model was employed to allow a comparison between the ninth (posttest only) group and the other groups. Correlations were computed between all variables and several regression analyses were performed. These results will be reported in the following order: pretest measures, behavior during training, effects of training, and correlational data.

Pretest Measures

Due to the stratified random assignment of subjects to the nine groups, no differences were expected between group means on either GRE-

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[6]This test was also adapted, with modifications, from Karlins et al. (1967), who reported significant correlations with their version of the immediate posttest of information seeking, ($r = .37$, $n = 65$, $p < .01$), and with the Unusual Uses Test ($r = .32$, $n = 65$, $p < .01$), but an insignificant correlation with the Wunderlich Personnel Intelligence Test ($r = -.18$, $n = 65$). In the pilot study, the experimenter also found that the delayed posttest of information seeking was related to the immediate posttest ($r = .63$, $n = 22$, $p < .01$), number of details noticed in a film ($r = .32$, $n = 35$, $p < .01$), and number of hypothetical film plots generated ($r = .28$, $n = 37$, $p < .10$). The scoring of the delayed posttest of information seeking was identical to that of the immediate posttest of information seeking.

Verbal scores or F Scale scores. A 9 x 13 analysis of variance of the GRE-Verbal scores and F Scale scores yielded F-ratios which were in fact not significant ($F = .944$ and $F = 1.54$ respectively, $df = 8,96$).

Behavior During Training

The degree of uncertainty aroused in the subjects by the films in relation to the training tasks may be inferred from the number of film viewings requested by the experimental groups before criterion was reached and by the number of times control group subjects wished to see the film. This is indicated in a 2 x 2 x 2 analysis of variance summarized in Table 1. Both training conditions required more film viewings than the control conditions ($F = 36.12$, $p < .001$), a finding which is not surprising in light of the fact that control subjects did not have to reach criterion.

TABLE 1

Analysis of Variance of Number of Film Viewings

Source	df	Sums of Squares	Mean Squares	F
Training (A)	1	35.77	35.77	36.12***
Version of film (B)	1	0.08	0.08	
Kind of training (C)	1	23.08	23.08	23.31***
A x B	1	0.01	0.01	
A x C	1	11.77	11.77	11.89***
B x C	1	7.01	7.01	7.08**
A x B x C	1	0.01	0.01	
Within groups	96	95.07	0.99	
Total	103	172.83		

***$p < .001$

**$p < .01$

More important, however, was the fact that there was a within-treatment difference: CA training required significantly more film viewings than HG training ($F = 23.31$, $p < .001$), suggesting that contrary to the results of a pilot study the CA treatment was more demanding than HG treatment. There was no main effect due to film version, but training conditions interacted with this variable ($F = 7.08$, $p < .01$). Newman-Keuls tests (Winer, 1962) to compare significant differences within interactions showed that cue-attendance training was the more demanding, particularly when accompanied by the structured version of the film. HG training, when accompanied by the U film, was significantly more demanding than HG with the S film.

Time to criterion measures were obtained from the tape recordings of the training sessions of the experimental groups. It was expected that the more uncertainty-arousing films would result in longer training sessions. Time scores were transformed to decimals and a training by subjects (4 x 13) analysis of variance was performed (Table 2).

TABLE 2

Analysis of Variance of Time Taken for Training

Source	df	Sums of Squares	Mean Squares	F
Training conditions	3	1373.86	457.95	4.5**
Within groups	12	952.02	79.33	
Residual	36	3639.72	101.10	
Total	51	5965.70		

** $p < .01$

Groups differed from each other with respect to the time for training they needed ($F = 4.5$, $p < .01$). Studentized Range Tests were used to compare time scores of the four experimental groups within each train-

ing condition. The tests revealed that there were significant differences due to version of film: CA training with the S film took more time than the same training with the U version ($p < .05$). The exact opposite happened within the HG training: The U version required more time for training than the S version ($p < .05$). This finding is in line with a previous study (Salomon & Sieber, 1970) in which corresponding groups (CA-S and HG-U) produced higher relative uncertainty scores than CA-U and HG-S groups. It is also congruent with results for the number of film viewings needed by the various experimental groups to reach criterion.

Effects of Training on Posttests

The effects of training were inferred from performance on the posttests of CA, HG, immediate information seeking, and delayed information seeking.

CA posttest. Results supported the first prediction. The number of reported cues was significantly larger in the experimental groups (Table 3).

TABLE 3

Analysis of Variance for Number of Reported Cues on CA Posttest

Source	df	Sums of Squares	Mean Squares	F
Training (A)	1	2423.11	2423.11	16.64***
Version of film (B)	1	55.53	55.53	
Kind of training (C)	1	764.65	764.65	5.25*
A x B	1	6.50	6.50	
A x C	1	499.84	499.84	3.43
B x C	1	13.88	13.88	
A x B x C	1	400.13	400.13	2.75
Within groups	96	13974.75	145.57	
Total	103	18138.42		

***$p < .001$

* $p < .05$

A main effect of training yielded an F-ratio of 16.64 ($p < .001$; $\omega^2 = .513$). Another main effect was due to the kind of training given ($F = 5.25$, $p < .05$; $\omega^2 = .22$). There was no effect due to version of film, nor did the other two variables interact with the latter. The finding that CA-trained subjects reported more cues on the posttest than other subjects was not surprising. This behavior was intensively reinforced for them. Important, however, is the finding that HG-trained subjects performed better than controls on a task which was equally novel to both ($p < .05$, Newman-Keuls test). This suggests that HG training had some transfer effect on another behavior (cue attendance). On the other hand, HG-trained subjects performed significantly less well than CA-trained ones, suggesting that the transfer effect was not as strong as direct training.

HG posttest. Similar, though not identical, results were obtained from analysis of the number of hypotheses generated on HG posttest (Table 4).

TABLE 4

Analysis of Variance for Number of Hypotheses Generated on HG Posttest

Source	df	Sums of Squares	Mean Squares	F
Training (A)	1	57.01	57.01	11.22**
Version of film (B)	1	0.24	0.24	
Kind of training (C)	1	0.08	0.08	
A x B	1	3.47	3.47	
A x C	1	2.77	2.77	
B x C	1	0.24	0.24	
A x B x C	1	7.01	7.01	
Within groups	96	487.99	5.[illegible]	
Total	103	558.82		

**$p < .01$

There was a significant main effect due to training ($F = 11.22$, $p < .01$; $\omega^2 = .407$), but no effect due to either film version or kind of training. Hence, unlike the test on number of reported cues, CA training was as effective on hypothesis generation as direct training was. While HG training improved cue-attendance behavior to a lesser degree than CA training, the latter improved hypothesis generation as much as HG training.

On both measures (number of cues and number of hypotheses), there was no significant difference between the scores of any of the control groups and the posttest-only group. This was revealed by using the Newman-Keuls test after a significant overall F-ratio was obtained from a 13 x 9 analysis of variance. It became apparent that exposure to the film accompanied by only a general introduction (no-training controls) did not result in learning when compared with the posttest-only group.

Effects of Training on Information-Seeking Behavior

Information-seeking behavior was measured by an immediate posttest (TOP) and by a delayed posttest (DET).

Number of questions on the TOP. Experimental groups asked significantly more informative questions on the TOP ($F = 6.25$, $p < .05$), than did control groups (Table 5). Training accounted for about 26% of the variance ($\omega^2 = .26119$).

TABLE 5

Analysis of Variance for Number of TOP Informative Questions

Source	df	Sums of Squares	Mean Squares	F
Training (A)	1	322.01	322.01	6.25*
Version of film (B)	1	45.77	45.77	.88
Kind of training	1	122.77	122.77	2.38
A x B	1	69.47	69.47	1.34
A x C	1	131.62	131.62	2.55
B x C	1	3.47	3.47	
A x B x C	1	7.01	7.01	
Within groups	96	4949.00	51.55	
Total	103	5651.14		

*p <.05

There was no significant difference between CA and HG conditions, nor were there significant differences due to versions of film ($F = 2.38$ and $.88$, respectively, neither one significant). This finding suggests that both training procedures increased, by about the same amount, the number of questions subjects asked on a transfer test, though no subject was trained directly to do so. There was also no difference between the control groups and the posttest-only group,[7] suggesting that the brief introduction and film exposure had no effect on changes in information-seeking behavior. Thus, the first two hypotheses received additional support: both training procedures affected information-seeking behavior, presumably through the mediation of aroused response uncertainty. It will be noted that although CA training appeared to be more demanding than HG training, the former did not affect information-seeking behavior more than the latter.

<u>Number of information queries on the DET</u>. The delayed posttest (DET) was given one week after training. Of the 117 subjects, 96 took the DET. To obtain equal group sizes, six subjects were dropped at random so that 10 persons remained in each group, or 90 all together. The DET provided only a measure of the number of informative items sought by each subject. The results indicated that experimental subjects maintained their tendency to request more information than control Ss. The difference between experimental and control groups remained significant ($F = 5.53$, $p < .05$; $\omega^2 = .233$). As with the TOP, no difference due to kind of training or version of film was noted (Table 6).

These findings are clearly congruent with those of Maltzman's study (1960), in which training for the emission of unusual responses resulted in higher criterion scores both immediately after training and one week later.

[7]Newman-Keuls test after 9 x 13 ANOVA.

TABLE 6

Analysis of Variance for Number of Information Queries on the Delayed Posttest (DET)

Source	df	Sums of Squares	Mean Squares	F
Training (A)	1	522.01	522.01	5.53*
Version of film (B)	1	60.01	60.01	
Kind of training (C)	1	19.47	19.47	
A x B	1	86.77	86.77	
A x C	1	2.77	2.77	
B x C	1	3.47	3.47	
A x B x C	1	43.16	43.16	
Within groups	96	9060.21	94.37	
Total	103	9797.89		

*p <.05

The results for the TOP and the DET lend additional support to the hypotheses about transfer of training. Subjects were trained either to notice cues or to generate hypotheses. The effects of these training procedures are reflected in the number of questions raised (TOP) and the number of informative items sought (DET). The supposed mediating link between training and posttests is the experimentally improved strategy of handling problem situations.

Effects of Training on Uncertainty Entailed in Responses

The measure of average group uncertainty as revealed by the distribution of questions is given by the Hg (group response uncertainty) coefficient. To obtain a group uncertainty measure (H), the probability of each question was computed on the basis of the response distribution generated by that group. Shannon's formula was applied ($N = 14$, the number of response categories), and H, and H_{max} were computed; relative uncertainty ratios (R_H) were compared by means of the t-test for proportions. Experimental groups were compared with control groups. H, H_{max}, and R_H were based on the total response distribution generated by each of the groups. The results are given in Table 7.

TABLE 7

Average Uncertainty Generated by Each Group on the TOP

	Training				Control			
	CA-S	CA-U	HG-S	HG-U	CA-S	CA-U	HG-S	HG-U
Number of responses	71	72	78	62	62	72	57	73
H	3.53	3.15	3.19	3.57	2.88	3.08	3.19	3.30
H_{max}	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80
R_H	.93	.83	.84	.94	.76	.81	.84	.87
t	1.98*		2.01*		.71		.44	

*p <.05

It became evident that the film version had a significant effect on average group uncertainty (as reflected in the Kurtosis of questions) in the experimental groups only. The differences between R_H of cells within the control group were not significant. CA-S experimental subjects produced higher R_H than CA-U, and HG-U experimental subjects produced higher R_H than HG-S. As the results suggest, exposure to the S film under the CA training procedure, and to the U film under the HG training procedure, affected later performance on a test which did not directly require either cue attendance or hypothesis generation. This effect was presumably due to a chain of intervening events involving cue attendance and the generation of alternative hypotheses. Differences in average response uncertainty due to the film version in the experimental groups support the expected interaction between task and uncertainty aroused by the films, which was also found in a previous study (Salomon & Sieber, 1969).

Correlational Data

Correlations between the measures reported above and others were computed separately for experimental (N = 52) and control (N = 65) groups, and are presented in Table 8. In the upper right-hand side of the table are the correlations obtained from the experimental group, and at the lower left side are those from the control group.

TABLE 8

Intercorrelations Among Response Variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
1. GRE-Verbal	--	-.22	.04	-.03	.24*	-.04	-.12	.26*	-.04	.00	-.31*	-.35**	-.05
2. F Scale	-.27*	--	-.28*	.07	-.21*	-.16	-.08	-.19	-.14	-.16	-.13	-.08	-.00
3. CA-PT, number of cues	.05	-.16	--	.25*	.48**	.27*	-.03	.48**	.22	.24*	.11	.14	.26*
4. CA-PT, number of slide viewings	.01	-.05	.47**	--	-.25*	.18	.34**	-.03	.09	.01	.02	-.05	-.06
5. CA-PT, time to respond	.06	-.05	.05	-.29*	--	.13	-.09	.61**	.17	-.05	.03	-.11	-.11
6. HG-PT, number of hypotheses	.08	.21*	.42**	.23*	.07	--	.10	.22*	.93**	.30*	.31*	.16	.32**
7. HG-PT, number of slide viewings	-.04	-.12	.14	.55*	-.23*	.06	--	-.34**	.05	.21	.25*	.19	.20
8. HG-PT, time to respond	.10	.10	.25*	-.19	.33**	.23*	-.51**	--	.22	-.12	-.19	-.21	-.12
9. HG-PT, surprisal scores	.10	.14	.48**	.14	-.01	.86**	.02	.23*	--	.32**	.35**	.28*	.16
10. TOP, number of questions	-.00	-.10	.39**	-.01	.12	.27*	.06	-.03	.48**	--	.58**	.45**	.46**
11. TOP, surprisal scores	.05	.06	.14	-.12	.19	.07	-.04	.11	.26*	.54**	--	.87**	.37**
12. TOP, average surprisal	.07	.10	.08	-.06	.16	.09	-.05	.13	.24*	.41**	.91**	--	.30*
13. DET, number of items	-.10	.09	.18	-.00	-.13	.21	.17	-.05	.00	.35**	.20	.19	--

Note: In the upper right-hand side are the correlations obtained from the experimental groups (N = 52), and in the lower left are those obtained from the control groups (N = 65).

*p <.05 for experimental group (N = 52) and for control group (N = 65).

**p <.01 for experimental group (N = 52) and for control group (N = 65).

Correlations with DET are based on 40 and 50 cases, respectively.

TOP scores (number of questions) correlated positively and significantly with number of reported cues on CA-PT (.24, $p < .05$, and $p < .01$) and with number of generated hypotheses on HG-PT (.30 and .27, $p < .05$). DET scores correlated with these variables in the experimental group but not in the control group. These measures of information seeking correlated .46 and .35 ($p < .01$) with each other. Number of reported cues and number of generated hypotheses correlated .27 and .42 with each other ($p < .05$ and $p < .01$, respectively). Although none of these correlations is high, the hypothesized relations between the various measures of uncertainty seem to emerge.

An interesting set of correlations occurred between response time on CA posttest and the number of posttest slide viewings requested by the subject.[8] Both measures are positively correlated with number of cues needed but are negatively correlated with each other (experimental Ss = -.25 and control Ss = -.29). It can be seen in Table 8 that in the experimental group the correlation between number of reported cues and number of slide viewings (.48, $p < .01$, versus .25, $p < .05$; the difference narrowly misses significance). In the control group the opposite can be observed: CA correlated .05 with response time, but .47 with number of slide-viewing requests (the difference is significant, $p < .05$). It was also found that the experimental groups needed significantly more time for their posttest responses before requesting another viewing of the stimulus slides ($F = 12.65$, $p < .001$), but did not differ significantly from control subjects with respect to number of slide viewings.

Thus, for certain subjects (mainly control subjects) the number of slide viewings seems to have been the major contributor to their cue-attendance scores, while for others (mainly experimental subjects) the major contributor was the time taken. An analysis of variance was done for the number of reported cues in the segment of time between the first and second viewing of slides. The test showed a significant difference

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[8] In HG-PT, subjects tended to note in writing the content of the slides. Consequently, re-viewing them was quite unnecessary. Therefore an analysis of the corresponding correlations produced by this test would be misleading.

($F = 10.64$, $p < .01$) between experimental and control groups. Thus, experimental subjects took in more information after a single viewing of the test slides, the reporting of which obviously required significantly more time. Due to training (regardless of which kind), experimental subjects apparently learned to encode and remember more information at a time and to reflect longer than control subjects. Therefore, their CA scores correlated higher with time measures than with requests for re-viewing the slides, while the opposite was true for control subjects.

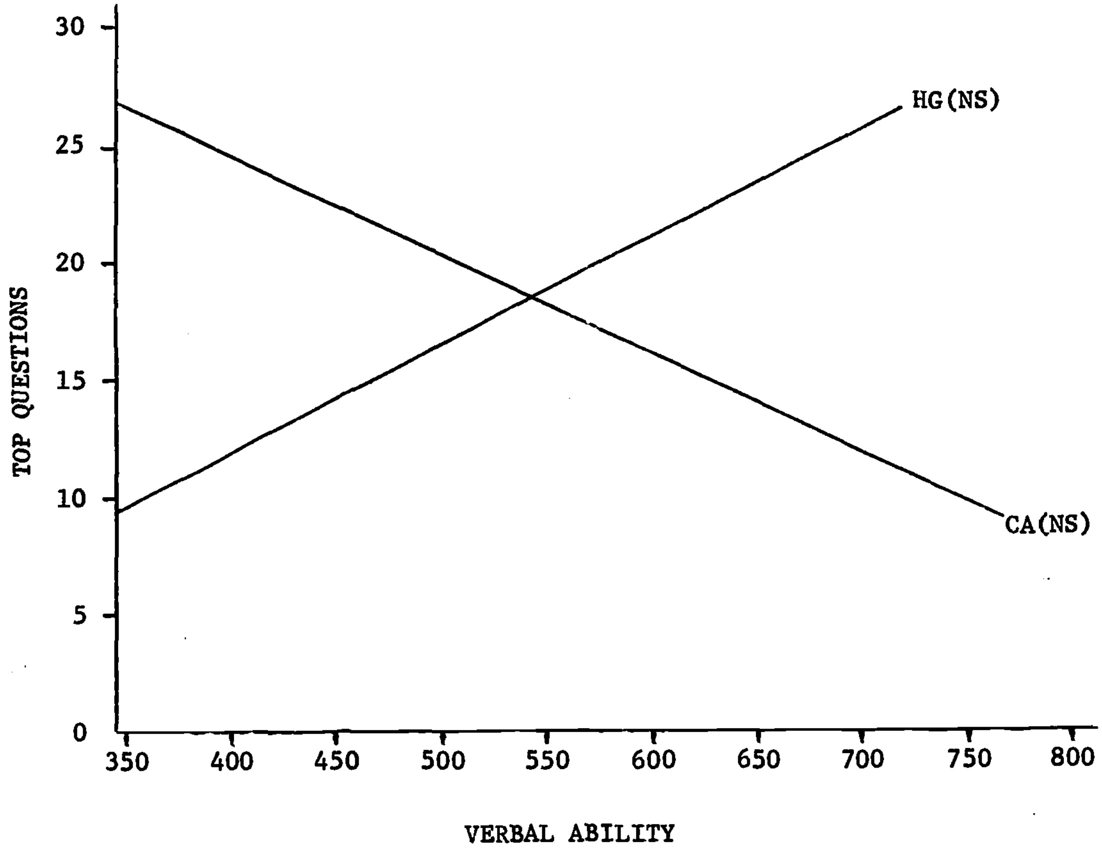
Table 8 shows that there are no correlations between TOP scores and GRE verbal scores in experimental or control groups. However, a cell-by-cell inspection of the correlations reveals that in the training groups the correlation between these two variables was as high as .35, or as low as -.30. Thus, regression analyses were done following tests of linearity (which revealed that the linearity assumption was met). TOP scores were regressed on GRE verbal scores for each cell in the experiment. An overall test for significant differences among the nine regression lines yielded an F-ratio of 2.15 ($p < .05$, $df = 8,99$). The t-tests used to compare pairs of regression slopes yielded no significant differences between control groups but showed a highly significant difference between the experimental groups (Figure 1). While in CA training with the U film, high GRE verbal scorers received low TOP scores; in HG training with the same film, high GRE scorers received high TOP scores, and low GRE scorers received low TOP scores ($t = 2.87$, $df = 24$, $p < .01$, two-tailed test).

The interaction of verbal ability and training, which is reflected in a transfer posttest, is congruent with Schroder et al. (1967) about the relations between intelligence and information processing as a manifestation of intellectual ability. However, in addition to their general explanation, the following interpretation can be offered. As noted earlier, the CA training required the subject to lift all conceivable restrictions on attention, thus to memorize and report unselectively details and cues without evaluating them for appropriateness, or trying to

FIGURE 1

Number of TOP Questions as a Function of Verbal Ability Scores

$F = 8.24$ ($df=1,22$; $p<.01$)



fit them into some given pattern. Subjects were asked only to attend to details but not to evaluate them. It might be hypothesized that this kind of behavior, when strongly reinforced, is incompatible with the application of different mental transformations to the same set of data, something which seems to be tapped by the GRE verbal test. The kind of behavior required by the CA training might therefore be inappropriate for persons of high intelligence. Their tendency to select, evaluate, and weigh incoming information may interfere with the CA-training requirements. It is important to note that GRE scores correlated with number of reported cues on CA-PT between -.13 and -.46 in all the CA (training or control) groups. The two correlated between +.13 and +.30 in the HG groups.

HG training seems to require another more selective and evaluative kind of information intake. Although hypothesis generation is facilitated, as it has been claimed, by unselected cue attendance, the act of generating new responses seems to require evaluation, comparison, and other operations which are measured by the GRE verbal test. Thus, high GRE verbal scorers benefit more from HG training, as the regression lines suggest.

Discussion

The results of the present experiment lend support to the hypotheses derived from the explication of the major processes underlying subjective response uncertainty. Training for the detailed examination of stimulus elements (cue attendance) and training for the generation of alternative responses (hypothesis generation) led to increased information acquisition and more intense information processing. Trained subjects studied in more detail the nature of posttest stimuli and took more time to do so. They generated more alternative hypothetical explanations to a new problem and devoted more time to elaborate on the information they perceived. These subjects sought more information when faced with a problem containing insufficient information, both immediately after training and a week later. Trained subjects' responses were spread over a relatively wide spectrum of categories. Since the training procedures affected such a variety of responses, it seems reasonable to conclude that a

general underlying method of handling problematic stimuli was affected.

Thus, on the basis of these results, we could suggest three things: (a) that in adults, at least, the detailed study of the stimulus facilitates the generation of alternative response complexes, and that the two processes facilitate conflict between alternative response tendencies. The latter state is then relieved by information seeking and hypothesis generation; (b) that one's subjective response uncertainty is modifiable through the training of the relevant mediating processes; (c) that subjective response uncertainty is a state which results to a significant extent from the individual's way of handling a problem: he changes foci of attention and analyzed the stimulus, and he generates alternative response complexes.

However, these generalizations need some qualification. Not all trained subjects benefited equally from the same training procedures, although all the subjects reached the specified criteria. Subjects who scored above the mean of the GRE verbal Test benefited most from HG training in terms of later information research, while those who scored below the mean benefited most from CA training. This disordinal interaction suggests a number of things.

First, it provides some support for our speculations about the kinds of behavior that underlie cue attendance and hypothesis generation. Individuals who have few transformational responses score low on a reasoning test because such tests require the use of many transformations or operations. In other words, a low scorer brings to bear upon the situation only a few alternative operations which he then tests. HG training, with the frequent shifting of attention and the variety of transformations it requires, puts too much cognitive strain on this individual. On the other hand, individuals who bring to a situation many well-learned transformational responses and can apply them interchangeably to the same data, also score higher on reasoning tests. These persons do not benefit much from CA training because it requires that they avoid using symbolic transformations and concentrate instead on unselective labeling, which, for them, produces cognitive strain. The negative correlations between GRE scores and CA posttest perfor-

mance and the positive correlations between GRE and HG posttest performance strongly support this interpretation.

This obtained interaction leads to another suggestion. It may very well be the case that individuals who differ in their transformational hierarchies approach the same complex stimulus differently, although the overt behavior they manifest (e.g., information search) may be the same. Results which support such a possibility are reported by Anderson (1967). Koran, McDonald, and Snow (1969) report a similar disordinal interaction between scores on the Hidden Figure Test and the effectiveness of learning how to ask analytic questions from either a written script or a videotape recorded model.

The conclusion is that although CA behavior facilitates HG behavior and both lead to increased uncertainty, people with different scores on a relevant aptitude test may employ each of these processes to different degrees and thus put more emphasis on either the first or second process.

In the present experiment, training was directed at increasing the subject's response uncertainty, and information seeking was conceived of as the result of response uncertainty. However, there may be a question as to a person's attempts to maximize information search in one limited area and his attempts to spread his search over different areas, as Karlins et al. (1967) did. While the former was reflected in the number of raised questions, the latter was reflected in their distribution over different classes of information. Perhaps experimental subjects learned to ask more questions, hence, to maximize information search in one area, sacrificing other relevant areas. Furthermore, they might have asked questions that, if answered, would result in information overload.

The analysis of the spread of informative questions raised by the subjects on the TOP over different categories, as revealed by the H_g coefficient (Table 7), indicates that the spread of questions was different in the experimental groups when compared to the control groups. Suedfeld and Streufert (1966) found that more "conceptually complex"

subjects (and as Sieber & Lanzetta, 1964, have shown, the more response-uncertain ones) ask for a greater amount of and a more novel type of information than "conceptually simple" subjects. Karlins and Lamm (1967) report similar findings. Thus, the findings of the present study indicate that both maximization (number of questions) and spread (number of covered information classes) took place, and that both processes were more intense in the experimental subjects. However, only those experimental groups which were exposed to what was the more uncertain film for them generated more diverse questions on the TOP. Thus, it may be concluded that while training led to an increase in the number of information queries, uncertainty in the film led to an increase in their diversity.

The chain of causal effects stressed in this study needs to be tested against other rival hypotheses. Such hypotheses would refer to the validity of the construct under discussion. Were people trained to become more "subjectively response uncertain"? Were they trained to be more fluent verbally with certain responses? Did they become more motivated to perform well on the various tests? Could it be that the training per se, rather than the improved mental behavior, led to the observed differences?

As for the increased verbal fluency, it is correct that the subjects received reinforcement for their verbal responses. It is also true that in both the TOP and the DET, rate of responding (number of different responses) was measured. Moreover, it could be argued that in the light of Maltzman's approach (1960), the increased fluency also led to increased originality of responses which was systematically reinforced in the present study. According to this reasoning, the reinforcements given in the present training sessions should have affected only certain response hierarchies. Only specific transfer to related response hierarchies could then be expected. However, there was a nonspecific transfer effect to new tasks which were not related to the training-emitted responses in any obvious way, suggesting that mediating responses accounted for the transfer. These, it seems, were the more accurate perception of uncertainty in the stimulus and the arousal of competing response complexes.

It may still be argued that some general tendency to be fluent and original was reinforced. Assuming that subjective response uncertainty is a state of mind dependent on the number and relative strength of aroused responses, the latter argument is perfectly in line with the expected outcomes of the study. It was reasoned that strategies of handling uncertain information were dealt with in this study. Increasing one's general fluency and originality in emitting alternative responses when faced with uncertainty is in full agreement with the above reasoning.

It has been argued that the experimental subjects became more motivated, and hence invested more time and effort in their test performance. It is difficult to adduce a reasonable counterargument to explain these findings. If the films and the training procedures were uncertainty arousing, as they were expected to be, then this aroused state has, according to Berlyne (1960), a motivating effect. Moreover, the conflict between responses, induced by the training, was clearly intended to be motivating. Higher subjective response uncertainty, as noted earlier, is a state of mind which individuals try to reduce to a tolerable level by various means, predominantly by seeking additional information and manipulating stored information. Consequently, the suggestion that the trained subjects became more motivated is reasonable and congruent with the rationale of the study.

However, the question of the motivating effects of subjective uncertainty is still not very clear. The degree to which one becomes engaged in resolving a conceptual conflict through epistemic behavior is not only a function of his degree of uncertainty. It is a common observation that two equally uncertain problems may still differ as to the intensity of conflict they create. Apparently, as Berlyne (1960) concluded, the degree of conflict (C) is a result of two components: the importance (ΣE) one attaches to the solution of the conflict and the uncertainty aroused by it (Σh), thus

$$C = \Sigma E \times \Sigma h$$

Hence, experienced conflict should vary with ΣE (importance of problem) when Σh (uncertainty) is held constant, or with Σh when ΣE is held constant. In the present experiment there is no reason to believe that ΣE has been affected; experimental subjects should not have become more interested in solving the problems presented in the posttest. The importance (ΣE) of the problems for them did not increase. Rather, the increased uncertainty they generated and experienced when faced with these problems (Σh) increased their motivation to seek more information.

Finally, there is the question as to whether improved cue-attendance or hypothesis-generation behaviors led to the observed changes in information search or if it was the training received. Training alone, regardless of the specific behavior trained for, may have accounted for the results. This rival hypothesis cannot easily be ruled out since the design did not include procedures to control for it. However, it can be claimed that if this were true, experimental subjects would not have shown improvements over control subjects on such a wide variety of behaviors. Artifacts such as "experimenter's demand," etc., usually tend to influence a rather narrow range of behaviors which are closely related to those trained for. This is not the case in the present study.

A number of questions are raised by the study. One problem is related to the generality of the claim that cue-attendance behavior facilitates the generation of alternative response complexes. It is possible to conceive of problem situations where the close examination of stimulus elements (that is, the generation of separate responses to different aspects or elements of the stimulus) may produce response uncertainty which is irrelevant to the task at hand. This would be the case with an anagram-like problem. The attendance to each letter separately would not lead to the generation of alternative combinations. There must be other cues, or units of analysis, which should be attended to. It may appear that the size and nature of the elements into which one analyzes a stimulus will depend on the nature of the stimulus itself and on the task to be accomplished. One is reminded at that point of Miller's chunks of information (1956) which are composed of numerous discrete bits. The chunks, rather than the more discrete bits or other

artificial units, are the ones which are operational. These chunks are stored and used for transformations. Miller points out (1962) that in speech, people use decisional units which are larger than individual words. These enable us to make perceptual decisions about what we are hearing by effectively narrowing the range of alternative meanings.

However, what constitutes a chunk or how the process of cue attendance and chunking coincide is not very definitely known. Nor is there very explicit knowledge about the process of generating response complexes and how this process relates to the process of chunking. It seems clear, though, that the cues which the subjects in this study had to notice and report could not be the same as those one would notice and process in another task.

References

Anderson, R. C. Individual differences and problem solving. In R. M. Gagne (Ed.), Learning and individual differences. Columbus, Ohio: Charles E. Merrill, 1967.

Attneave, F. Applications of information theory to psychology. New York: Holt, Rinehart and Winston, 1959.

Bieri, J. Cognitive complexity and personality development. In O. J. Harvey (Ed.), Experience, structure and adaptability. New York: Springer, 1966.

Berlyne, D. E. Structure and direction in thinking. New York: John Wiley, 1965.

Birch, H. G., & Rabinowitz, H. S. The negative effect of previous experience on productive thinking. Journal of Experimental Psychology, 1963, 41, 121-125.

Cronbach, L. J. The two disciplines of scientific psychology. The American Psychologist, 1957, 12, 671-684.

Driscoll, J. M., Tongoli, J. J., & Lanzetta, J. T. Choice conflict and subjective uncertainty in decision making. Psychological Reports, 1966, 18, 427-432.

Garner, W. R. Uncertainty and structure as psychological concepts. New York: John Wiley, 1962.

Glanzer, M. Individual performance, R-R theory and perception. In R. M. Gagné (Ed.), Learning and individual differences. Columbus, Ohio: Charles E. Merrill, 1967.

Guilford, J. P. The nature of human intelligence. New York: McGraw-Hill, 1967.

Harvey, O. J., Wyer, R. S., & Hautaluoma, J. E. Some cognitive and affective determinants of differentiation and integration. Technical Report No. 8, 1964, Contract Number 1147(07), Office of Naval Research.

Hunt, J. McV. The psychological basis for using pre-school enrichment as an antidote for cultural deprivation. Merrill-Palmer Quarterly, 1964, 10, 209-248.

Kagan, J. Information processing in the child. In P. H. Musser, J. J. Conger, & J. Kagan (Eds.), Reading in child development and personality. New York: Harper & Row, 1965.

Kagan, J. Reflection-impulsivity: The generality and dynamics of conceptual tempo. Journal of Abnormal Psychology, 1966, 71(1), 17-24.

Karlins, M. Conceptual complexity and remote associative proficiency as creative variables in a complex problem-solving task. Journal of Personality and Social Psychology, 1967, 6(3), 264-278.

Karlins, M., & Lamm, H. Information search as a function of conceptual structure in a complex problem-solving task. Journal of Personality, 1967, 5(4), 456-459.

Karlins, M., Lee, R. E., & Schroder, H. M. Creativity and information search in a problem-solving context. Psychonomic Science, 1967, 8(4), 165-166.

Kessen, W. The strategy of instruction. In J. Bruner (Ed.), Learning about learning: A conference report. Cooperative Research Monograph No. 15, 1966, Contract Number OE-12019, U.S. Department of Health, Education, and Welfare.

Koran, M. L., McDonald, F. J., & Snow, R. E. Effects of teacher trainee aptitudes on observational learning. Paper presented at the meeting of the American Educational Research Association, Los Angeles, February 1969.

Lanzetta, J. T. Uncertainty as a motivating variable. Paper presented at the Conference on Experimental Social Psychology, Vienna, Austria, April 1967.

Long, B. H., & Ziller, R. C. Dogmatism and predecisional information search. Journal of Applied Psychology, 1965, 49, 376-378.

Long, E. R., Reid, L. S., & Henneman, R. H. An experimental analysis of set: Variables influencing the identification of ambiguous visual stimulus-objects. American Journal of Psychology, 1960, 73, 553-562.

Maltzman, I. On the training of originality. Psychological Review, 1960, 67, 229-242.

Mandler, G. Verbal learning. In G. Mandler, P. Mussen, N. Kogan, & M. A. Wallach (Eds.), New directions in psychology III. New York: Holt, Rinehart and Winston, 1967.

Mednick, S. A. The associative basis of the creative process. Psychological Review, 1962, 69(3), 220-232.

Miller, G. A. The magical number seven, plus or minus two: Some limits on our capacity for processing information. Psychological Review, 1956, 63, 81-97.

Miller, G. A. Some psychological studies of grammar. American Psychologist, 1962, 17, 748-762.

Salomon, G., & Sieber, J. E. Relevant subjective response uncertainty as a function of stimulus-task interaction. American Educational Research Journal, 1970, 7(3), 337-349.

Schroder, H. M., Driver, P. J., & Streufert, S. A. Human information processing. New York: Holt, Rinehart, and Winston, 1967.

Sieber, J. E. Individual differences in decision making. Research and Development Memorandum No. 23, Stanford Center for Research and Development in Teaching, 1968.

Sieber, J. E., & Lanzetta, J. T. Conflict and conceptual structure as determinants of decision-making behavior. Journal of Personality, 1964, 32(4), 622-642.

Sieber, J. E., & Lanzetta, J. T. Some determinants of individual differences in predecision information-processing behavior. Journal of Personality and Social Psychology, 1966, 4(5), 561-571.

Snow, R. E., & Salomon, G. Aptitudes and instructional media. AV Communication Review, 1968, 16(4), 341-357.

Suedfeld, P., & Streufert, S. Information search as a function of conceptual and environmental complexity. Psychonomic Science, 1966, 4(10), 351-352.

Tripodi, T., & Bieri, J. Cognitive complexity as a function of own and provided constructs. Psychological Reports, 1963, 13, 26.

Winer, B. J. Statistical principles in experimental design. New York: McGraw-Hill, 1962.